NEW

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 1 - SITE INFORMATION AND ASSESSMENT

EPA

I. IDENTIFICATION
01 STATE: IL | 02 SITE NUMBER: 3890008946

II. SITE NAME AND LOCATION

01 SITE NAME	02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER
Argonne National Laboratory-Illinois (ANL-IL) Unlined Holding Basin at Sewage Treatment Plant	9700 South Cass Avenue

03 CITY	04 STATE	05 ZIP CODE	06 COUNTY	07 COUNTY CODE	08 CONG. DIST
Argonne	IL	60439	DuPage	043	13

09 COORDINATES: LATITUDE 41° 42' 28.0" | LONGITUDE 87°58'50"

10 DIRECTIONS TO SITE: From I-55 turn south on Cass Ave. and then west onto the Northgate entrance road to ANL. The Unlined Holding Basin is 500 feet north of Bluff Road and 800 feet east of Railroad Drive at the ANL Sewage Treatment Plant.

III. RESPONSIBLE PARTIES

01 OWNER	02 STREET
U.S. Department of Energy (DOE-CH)	9800 South Cass Avenue

03 CITY	04 STATE	05 ZIP CODE	06 TELEPHONE NUMBER	
Argonne	IL	60439	(312) 972-2271	

07 OPERATOR	08 STREET
Argonne National Laboratory	9700 South Cass Avenue

09 CITY	10 STATE	11 ZIP CODE	12 TELEPHONE NUMBER	
Argonne	IL	60439	(312) 972-3998	Aubrey Smith Envir. Compliance Officer

13 TYPE OF OWNERSHIP (Check one)
☐ A. PRIVATE ☒ B. FEDERAL Department of Energy (Agency name) ☐ C. STATE ☐ D. COUNTY ☐ E. MUNICIPAL
☐ F. OTHER (Specify) ☐ G. UNKNOWN

14 OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)
☐ A. RCRA 3001 DATE RECEIVED: / / (MONTH DAY YEAR) ☐ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: / / (MONTH DAY YEAR) ☒ C. NONE

IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION
☒ YES DATE 1/13/88 (MONTH DAY YEAR)
☐ NO

BY (Check all that apply)
☒ A. EPA ☐ B. EPA CONTRACTOR ☒ C. STATE ☐ D. OTHER CONTRACTOR
☐ E. LOCAL HEALTH OFFICIAL ☐ F. OTHER (Specify)
CONTRACTOR NAME(S)

02 SITE STATUS (Check one)	03 YEARS OF OPERATION
☒ A. ACTIVE ☐ B. INACTIVE ☐ C. UNKNOWN	1950 (BEGINNING YEAR) / (ENDING YEAR) ☐ UNKNOWN

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED: This site has radioisotopes (plutonium, cesium, strontium, uranium and tritium) residual soil contamination from holding ANL wastewater. It is normally a dry unlined holding basin which on an emergency basis receives water from Sewage Treatment Plant lab tanks.

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION: Potential for radioisotopes in groundwater and drinking water from dolomite aquifer wells. It presents a potential for contamination of ANL potable water.

V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)
☐ A. HIGH (Inspection required promptly) ☐ B. MEDIUM (Inspection required) ☒ C. LOW (Inspect on time available basis) ☐ D. NONE (No further action needed; complete current disposition form)

VI. INFORMATION AVAILABLE FROM

01 CONTACT	02 OF (Agency/Organization)	03 TELEPHONE NUMBER
Barry Fritz	DOE-CH, Operational & Envir. Safety Division	(312) 972-2271

04 PERSON RESPONSIBLE FOR ASSESSMENT	05 AGENCY	06 ORGANIZATION	07 TELEPHONE NUMBER	08 DATE
C. L. Cheever	DOE	ANL-IL	(312) 972-3311	3/24/88 (MONTH DAY YEAR)

EPA FORM 2070-12 (7-81)

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 2 - WASTE INFORMATION

I. IDENTIFICATION

01 STATE	02 SITE NUMBER
IL	3890008946

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES (Check all that apply)

- ☐ A. SOLID
- ☐ B. POWDER, FINES
- ☐ C. SLUDGE
- ☐ D. OTHER _____ (Specify)
- ☐ E. SLURRY
- ☒ F. LIQUID
- ☐ G. GAS

02 WASTE QUANTITY AT SITE (Measures of waste quantities must be independent)

TONS _____

CUBIC YARDS Unknown

NO. OF DRUMS _____

03 WASTE CHARACTERISTICS (Check all that apply)

- ☐ A. TOXIC
- ☐ B. CORROSIVE
- ☒ C. RADIOACTIVE
- ☐ D. PERSISTENT
- ☐ E. SOLUBLE
- ☐ F. INFECTIOUS
- ☐ G. FLAMMABLE
- ☐ H. IGNITABLE
- ☐ I. HIGHLY VOLATILE
- ☐ J. EXPLOSIVE
- ☐ K. REACTIVE
- ☐ L. INCOMPATIBLE
- ☐ M. NOT APPLICABLE

III. WASTE TYPE Radioactivity in waste water

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE			
OLW	OILY WASTE			
SOL	SOLVENTS			
PSD	PESTICIDES			
OCC	OTHER ORGANIC CHEMICALS			
IOC	INORGANIC CHEMICALS			
ACD	ACIDS			
BAS	BASES			
MES	HEAVY METALS			

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently cited CAS numbers)

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
MES	Plutonium	7440-07-5	Unlined holding basin	272	pCi/gram
MES	Cesium-137	999	Unlined holding basin	49.6	pCi/gram
MES	Strontium-90	999	Unlined holding basin	8.5	pCi/gram
MES	Uranium	999	Unlined holding basin	23.4	pCi/gram
MES	Tritium	10028-17-8	Unlined holding basin	Unknown	pCi/gram

V. FEEDSTOCKS (See Appendix for CAS numbers)

CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS			FDS		
FDS			FDS		
FDS			FDS		
FDS			FDS		

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

(24) Environmental Radioactivity at ANL, 1958 (ANL-6047) pg. 35
(25) Environmental Radioactivity at ANL, 1959 (ANL-6282) pgs. 31, 32, 38, 40, 41.
(26) Environmental Radioactivity at ANL, 1960-61 (ANL-6736) pgs. 41, 42, 45, 46.
(27) 1985 Annual Site Environmental Report for ANL (ANL-86-13) pgs. 37, 38, 39.
(6) Site Plan (ANL map) 3-15-84 revision
(7) ANL map with PA legend and locations.

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
IL	3890008946

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 [X] A. GROUNDWATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED: 33,000
02 [ ] OBSERVED (DATE _____) [X] POTENTIAL [ ] ALLEGED
04 NARRATIVE DESCRIPTION

SEE CONTINUATION SHEET

01 [ ] B. SURFACE WATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED: _____
02 [ ] OBSERVED (DATE _____) [ ] POTENTIAL [ ] ALLEGED
04 NARRATIVE DESCRIPTION

01 [X] C. CONTAMINATION OF AIR
03 POPULATION POTENTIALLY AFFECTED: 35,000 in 3 miles
02 [ ] OBSERVED (DATE _____) [X] POTENTIAL [ ] ALLEGED
04 NARRATIVE DESCRIPTION

Potential for low level tritium water vapor or dust from soil.

01 [ ] D. FIRE/EXPLOSIVE CONDITIONS
03 POPULATION POTENTIALLY AFFECTED: _____
02 [ ] OBSERVED (DATE _____) [ ] POTENTIAL [ ] ALLEGED
04 NARRATIVE DESCRIPTION

01 [X] E. DIRECT CONTACT
03 POPULATION POTENTIALLY AFFECTED: _____
02 [ ] OBSERVED (DATE _____) [X] POTENTIAL [ ] ALLEGED
04 NARRATIVE DESCRIPTION

01 [X] F. CONTAMINATION OF SOIL
03 AREA POTENTIALLY AFFECTED: .2 acres
02 [X] OBSERVED (DATE 1959) [ ] POTENTIAL [ ] ALLEGED
04 NARRATIVE DESCRIPTION

Soil in the holding basin is contaminated with plutonium, cesium-137, strontium-90, uranium and tritium isotopes.

01 [X] G. DRINKING WATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED: 33,000
02 [ ] OBSERVED (DATE _____) [X] POTENTIAL [ ] ALLEGED
04 NARRATIVE DESCRIPTION

SEE CONTINUATION SHEET

01 [ ] H. WORKER EXPOSURE/INJURY
03 WORKERS POTENTIALLY AFFECTED: _____
02 [ ] OBSERVED (DATE _____) [ ] POTENTIAL [ ] ALLEGED
04 NARRATIVE DESCRIPTION

01 [ ] I. POPULATION EXPOSURE/INJURY
03 POPULATION POTENTIALLY AFFECTED: _____
02 [ ] OBSERVED (DATE _____) [ ] POTENTIAL [ ] ALLEGED
04 NARRATIVE DESCRIPTION

CONTINUATION SHEET

Part 3 - Description of Hazardous Conditions and Incidents

ANL-IL IL 3890008946

Unlined Holding Basin at Sewage Treatment Plant

Groundwater Contamination:

The potential for groundwater contamination exists. Groundwater in some of the ANL-IL facility is in the perched condition because of the relative impermeability of the underlying silty clay. This clay can restrict downward water flow and create a lateral perched water flow condition. The groundwater pattern in the area would probably follow the area topography, flowing southeasterly toward the Des Plaines River. Contaminated water may percolate downward into the perched groundwater and migrate in a southeasterly direction offsite. (Ref. (5) p. 2.)

Population = 3,000 employees + 30,000 residents within 3 miles and north of the river.

Drinking Water Contamination:

In the vicinity of ANL-IL, only subsurface water (from both shallow and deep aquifers) and Lake Michigan water are used for drinking purposes. The potential for contamination of groundwater used for drinking purposes does exist. Two principal aquifers are used as water supplies in the vicinity of ANL-IL. The upper aquifer is the Niagaran-Alexandrian dolomite which is about 200 ft. thick in the ANL-IL area and has a piezometric surface between 50 and 100 ft. below the ground surface. The lower aquifer is the Galesville sandstone which lies between 490 and 1,500 ft. below the surface. Maquoketa Shale separates the aquifers and retards hydraulic connection between the aquifers.

The four domestic water wells currently in use at ANL-IL are about 300 ft. deep in the the Niagaran dolomite. Three wells are northwest of the site. The nearest well is approximately 1,000 ft. north of the site. Samples from the nearest drinking water well have shown levels of tritium about 1% of the U. S. EPA drinking water standard. Together, the four wells serve the more than 3,000 employees at the ANL-IL facility.

Population = 3,000 employees + 30,000 residents within 3 miles and north of the Des Plaines River.

(Ref. (1) p. 8, 12, Ref. (2) p. 6, Ref. (5) p. 1-2.)

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION

01 STATE	02 SITE NUMBER
IL	3890008946

II. HAZARDOUS CONDITIONS AND INCIDENTS (Continued)

01 ☐ J. DAMAGE TO FLORA — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ K. DAMAGE TO FAUNA — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION (Include name(s) of species)

01 ☐ L. CONTAMINATION OF FOOD CHAIN — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ M. UNSTABLE CONTAINMENT OF WASTES — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
(Spills/runoff/standing liquids/leaking drums)
03 POPULATION POTENTIALLY AFFECTED: _____ 04 NARRATIVE DESCRIPTION

01 ☐ N. DAMAGE TO OFFSITE PROPERTY — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ P. ILLEGAL/UNAUTHORIZED DUMPING — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

05 DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR ALLEGED HAZARDS

III. TOTAL POPULATION POTENTIALLY AFFECTED: SEE CONTINUATION SHEET

IV. COMMENTS

The unlined holding basin has only been used on rare occasions (less than annual) for holdup of wastewater from the ANL Lab Sewer System concrete holding tanks.

V. SOURCES OF INFORMATION (Cite specific references, e.g. state files, sample analysis, reports)

SEE CONTINUATION SHEET

CONTINUATION SHEET

Part 3 - Description of Hazardous Conditions and Incidents

ANL-IL IL 3890008946

Unlined Holding Basin at Sewage Treatment Plant

Total Population Potentially Affected:

33,000 (3,000 employees + 30,000 residents within 3 miles and north of the Des Plaines River.) (Ref. (1) p. 8.)

Sources of Information:

(1) 1986 Annual Site Environmental Report for Argonne National Laboratory (Report #ANL-87-9).

(5) ANL-IL Intra-laboratory memo to N. W. Golchert from S. Y. Tsai; Subject: Groundwater Monitoring Plan for the 317-319 Area; September 17, 1985.

(6) Site Plan (ANL map), January 9, 1986.

(7) ANL map with PA legend and locations, April 1988.

(24) Environmental Radioactivity at ANL, 1958 (ANL-6047) pg. 35

(25) Environmental Radioactivity at ANL, 1959 (ANL-6282) pgs. 31, 32, 38, 40, 41.

(26) Environmental Radioactivity at ANL, 1960-61 (ANL-6736) pgs. 41, 42, 45, 46.

(27) 1985 Annual Site Environmental Report for ANL (ANL-86-13) pgs. 37, 38, 39.

ANL-86-13

ANL-86-13

1985 ANNUAL SITE ENVIRONMENTAL REPORT FOR ARGONNE NATIONAL LABORATORY

by

N. W. Golchert, T. L. Duffy,
and J. Sedlet

ARGONNE NATIONAL LABORATORY, ARGONNE, ILLINOIS

Operated by THE UNIVERSITY OF CHICAGO
for the U. S. DEPARTMENT OF ENERGY
under Contract W-31-109-Eng-38

Summary Report for Preliminary Assessment of the ANL-IL

Unlined Holding Basin at Sewage Treatment Plant

4/13/88

The Unlined Holding Basin at the ANL Sewage Treatment Plant has been contaminated by the holdup of radioactive wastewater pending processing. Samples from the nearest drinking water well have shown levels of tritium about 1% of the EPA drinking water standard.

Recommendations:

(1) Sample the soil in the basin to assess the depth of radioactivity and the presence of toxic chemicals for subsequent removal action.

(2) Complete a Site Inspection (SI).

(3) Following evaluation, remove significant residual radioactive contaminants and ship the contaminated soil to a radioactive waste disposal site.

Since both alpha and beta activities from waste water were found in Sawmill Creek, increases in the Des Plaines River from this source should be found in both types of activity. This is additional evidence that the beta activities in the River were due to fallout. As was the situation with Des Plaines River water, Sawmill Creek water is apparently sufficiently diluted so that the Creek has a negligible effect on the radioactivity of the Des Plaines River bed.

TABLE XVII

NONVOLATILE RADIOACTIVITY IN BOTTOM SILT FROM PONDS ON ANL SITE, 1958

Month	No. of Samples	Alpha Activity ($\mu\mu$c/g)		Beta Activity ($\mu\mu$c/g)	
		Max.	Avg.	Max.	Avg.
April	4	891[a]	243	1217[a]	355
	3	31[b]	27[b]	74[b]	67[b]
May	3	51	37	68	63
July	4	462[a]	132	798[a]	256
	3	22[b]	21[b]	86[b]	75[b]
November	4	1070[a]	297	2002[a]	561
	3	68[b]	39[b]	102[b]	80[b]
Average		187		325	
		32[b]		71[b]	

[a] Storage lagoon for contaminated waste water.

[b] Excluding the storage lagoon.

Total activities in bottom silt from ponds on the ANL site are given in Table XVII. The storage lagoon for contaminated waste water contained approximately 10 to 40 times the normal alpha and beta activities found in bottom silt. The active nuclides found in these samples were the same as those found in water from this lagoon (see Section C-2). The shorter-lived fission products predominant in fallout (e.g., Sr^{89}, Ce^{141}, $Zr\text{-}Nb^{95}$) were absent or present in much smaller concentrations than the long-lived fission products. One of the ponds on the site contained abnormal concentrations of natural activity, and these results will be discussed below. All other samples from the ANL ponds contained concentrations of alpha and beta activities similar to those found earlier. All alpha activities were normal, while a few of the samples contained 25 to 50 $\mu\mu c\beta/l$ of fission product fallout.

The alpha activities in bottom silt from lakes and streams near ANL (Tables XVIII and XIX) were normal for each particular body of water. The average beta activities were about 40 $\mu\mu$c/g higher than found in other years, due to high concentrations of fallout activity in a large fraction of the samples. Since all samples were collected during periods of relatively high fallout, the average beta activity is abnormally high. The July sample from McGinnis Slough (240 $\mu\mu$c/g) contained the second highest concentration of beta activity found this far off the Laboratory site. The highest sample, collected in August, 1952, from the Des Plaines River below the ANL site, contained 248 $\mu\mu$c/g. The high samples collected in 1958, all decayed

Differences between samples collected on the same day from both locations, such as were found on January 28 and March 13, were due to differences in the amount of fallout activity. Usually the samples collected upstream from the mouth of Sawmill Creek were higher, and this is reflected in the averages. The average values, about 70 $\mu\mu c/l$, were about two times greater than in the past several years as a result of the relatively large amount of fallout during the first part of 1959. The Sr^{90} content of the River at both locations decreased from 3.6 $\mu\mu c/l$ in February to about 1 $\mu\mu c/l$ in December; during the same period the Sr^{89} content decreased from 68 $\mu\mu c/l$ to less than 1 $\mu\mu c/l$. The Cs^{137} concentrations were about the same in the Des Plaines River as in Sawmill Creek above the site.

The results indicate that the activity in Sawmill Creek did not increase the activity in the Des Plaines River to any significant degree. This is reasonable in view of the large dilution of Sawmill Creek water by the much greater volume of water in the River.

3. Other Waters

The total activities in water samples collected from ponds on the ANL site are given in Table XI. The average alpha activity in the natural ponds, 2.4 $\mu\mu c/l$, was normal and similar to previous yearly averages. The two highest alpha activities in this group of samples, 5.9 and 3.5 $\mu\mu c/l$, were obtained in September and December from the same pond (location 11G in Figure 9). These results are unusual in that more than 75% of the surface water samples collected in the Chicago area contained less than 3 $\mu\mu c/l$. About 90% of the alpha activity in the two samples from the pond at 11G was due to uranium. This is also abnormal since uranium accounts for 50 to 75% of the total activity in ordinary surface water. Plutonium and thorium were not detected in these samples; the total beta activities were normal and several times greater than the alpha activities. The reason for this small increase in uranium content is not known at present, but is being investigated. Contamination by ANL operations is possible but unlikely. The samples collected from this pond in April and May contained normal amounts of both alpha activity and uranium, approximately 2 $\mu\mu c\alpha/l$ and 1.3 $\mu\mu cU/l$.

The highest alpha activities in the ANL ponds were found in water from a pond used occasionally to store contaminated waste water. As shown in the table, some of the samples from this pond contained alpha activities three to five times higher than in normal surface water. About three-quarters of this activity was due to uranium and plutonium. For example, the sample collected on July 31 contained 14 $\mu\mu c$ of alpha activity/l, 5.6 $\mu\mu c$ of uranium/l, and 3.5 $\mu\mu c$ of plutonium/l. The thorium concentration was only 0.2 $\mu\mu c/l$. This pond is also used to store excess uncontaminated waste water, and at times contains only rain water. However, the bottom of

the pond has adsorbed considerable activity from contaminated water in the past, so some of the activity found in the 1959 samples may have been leached from the bottom by uncontaminated waste water or rain water present in the pond at the time of sampling.

TABLE XI

NONVOLATILE RADIOACTIVITY IN PONDS ON ANL SITE, 1959

Date Collected	No. of Samples	Alpha Activity ($\mu\mu$c/l)		Beta Activity ($\mu\mu$c/l)	
		Max	Avg	Max	Avg
March 13	3	3.2	2.0	134	78
	1[a]	3.8	-	59.6	-
April 30	2	2.6	2.4	90.2	85.5
	1[a]	6.7	-	72.1	-
May 28	2	1.8	1.8	40.0	39.5
	1[a]	6.3	-	75.0	-
July 31	1	1.5	-	20.7	-
	1[a]	14.0	-	78.0	-
September 30	2	5.9	3.3	15.2	11.8
December 8	3	3.5	3.0	15.6	14.0
	1[a]	3.0	-	18.9	-
Annual	18	14.0[a]	3.6	134	49
Summary	13[b]	5.9	2.4	134	44

[a]Storage pond for contaminated waste water.

[b]Excluding samples from storage pond.

The beta activities in the ANL ponds were up to ten times higher than normal during the first part of the year as a result of fallout. Beta activities in the past have varied between 7 and 15 $\mu\mu$c/l during periods of little fallout. By December the beta activities had decreased to nearly normal values. Similar beta activities were found throughout the year at sampling locations off the Argonne site. The decrease during the year followed the decrease in fallout in air and rain. Because of the large amount of fallout early in the year, the average beta activity, about 45 $\mu\mu$c/l, was about 20 $\mu\mu$c/l higher than the averages for the past several years.

ANL-6282

TABLE XVI

RADIOACTIVITY IN BED OF SAWMILL CREEK, 1959

Location	Date	Micromicrocuries per gram						
		Alpha	Beta	U	Th	Pu	Sr^{90}	Cs^{137}
At waste water outfall	May 20	35	108	10.8	0.64	1.2	<0.4	-
10 yards below outfall	May 20	30	93	5.9	2.3	1.3	<0.5	-
20 yards below outfall	May 20	26	76	3.3	1.2	2.9	<0.4	-
30 yards below outfall	May 20	14	72	1.3	0.75	0.30	<0.2	-
40 yards below outfall	May 20	14	51	1.0	0.55	0.13	<0.4	-
20 yards below outfall	Jan. 28	87	147	23.0	-	18.2	2.4	8.1
20 yards below outfall	Nov. 18	75	208	31 7	-	9.4	1.6	4.0
Below outfall, East Bank	June 17	47	61	-	-	-	-	-
Below outfall, 5 ft from East Bank	June 17	15	45	-	-	-	-	-
Below outfall, 5 ft from West Bank	June 17	37	226	-	-	-	-	-
Below outfall, West Bank	June 17	22	67	-	-	-	-	-
Above ANL Site	May 20	26	122	2.2	3.1	<0.1	<0.2	-

TABLE XVII

RADIOACTIVITY IN SELECTED BOTTOM SILT SAMPLES, 1959

Location	Date	Micromicrocuries per gram						
		Alpha	Beta	U	Th	Pu	Sr^{90}	Cs^{137}
Des Plaines River, Lemont (below Sawmill Creek)	May 20	23	327	1.9	1.6	<0.1	0.45	-
Des Plaines River, Lemont (below Sawmill Creek)	Aug. 20	25	198	1.3	-	-	<0.4	2.7
Des Plaines River, Willow Springs (above Sawmill Creek)	May 20	23	75	1.4	1.3	<0.1	0.23	-
Des Plaines River, Willow Springs (above Sawmill Creek)	Sept. 29	26	231	2.6	-	-	<0.3	3.7
DuPage River, Naperville	Mar. 13	94	94	2.3	8.2	<0.1	<3	-
DuPage River, Channahon	Mar. 13	29	195	1.4	-	-	<2	-
McGinnis Slough, U.S. Rt. 45 and Ill. Rt. 7	Sept. 30	25	39	2.5	2.0	<0.05	-	-
Lake Michigan, 98th St., Chicago	May 28	4	28	0.53	-	-	<0.04	-
Storage Pond, ANL Site (10M)	Mar. 13	485	546	23.4	-	272	8.5	49.6
Pond, ANL Site (3F)	Mar. 13	60	81	1.2	3.8	<0.05	-	-
Pond, ANL Site (3F)	Sept. 30	30	54	2.0	<0.1	<0.1	-	-
Pond, ANL Site (11G)	May 17	23	69	2.1	1.8	<0.1	<1.2	-
Creek, ANL Site (13G)	June 11	27	197	1.5	-	-	0.45	7.1

None of the alpha activities was above normal. About one-third of the samples contained above-average concentrations of beta activity due to fallout, and the high samples were about equally distributed, on a percentage basis, above and below Sawmill Creek. In those samples containing normal amounts of beta activity, the alpha-to-beta ratio was fairly constant. However, unusually high beta activities were not accompanied by high alpha activities. If Argonne waste water had added significantly to the activity of the Des Plaines River bed below the Creek, high alpha as well as high beta activities would be expected. All the results indicate that Sawmill Creek had little, if any, effect on the activity in the bed of the Des Plaines River.

The total activities in ponds and in a few drainage ditches on the ANL site are given in Table XVIII.

TABLE XVIII

NONVOLATILE RADIOACTIVITY IN BOTTOM SILT FROM PONDS ON ANL SITE, 1959

Date Collected	No. of Samples	Alpha Activity ($\mu\mu$c/g)		Beta Activity ($\mu\mu$c/g)	
		Max	Avg	Max	Avg
March 13	3	60	35	151	95
	1[a]	485	-	546	-
April 30	2	24	24	215	142
	1[a]	486	-	644	-
May 28	2	24	22	66	61
	1[a]	473	-	648	-
June 11	3	28	26	197	187
July 31	7	28	25	439	167
	1[a]	109	-	145	-
September 30	2	30	26	65	60
December 8	4	23	21	117	84
	1[a]	505	-	506	-
Annual Summary	28	505[a]	94	648[a]	192
	23[b]	60	25	439	125

[a]Storage pond for contaminated waste water.

[b]Excluding samples from storage pond.

Samples from the storage pond for contaminated waste water contained from 4 to 20 times the normal concentrations of alpha activity and 2 to 8 times the normal beta activity. The sample collected on March 13 was analyzed for uranium, plutonium, Cs^{137}, and Sr^{90}, and abnormally large amounts of these activities were found. The large amount of activity in the bed of this pond had accumulated over a period of years from the contaminated water stored at intervals in the pond.

Samples were collected on June 11, July 31, and December 8, from a drainage ditch at location 13G that carries scrubbing water from a burner used for disposal of metallic sodium. Both inactive and neutron-irradiated sodium is burned in this equipment, but contaminated scrub water is not knowingly discharged to the ditch. None of the samples contained detectable amounts of Na^{22} or Na^{24}. The alpha activities were all normal, and some samples contained appreciable concentrations of fission products, presumably from fallout.

One sample collected on March 13, from a pond near the southern edge of the ANL site (location 3F) contained 60 $\mu\mu$c of alpha activity per gram, about twice the normal concentration. The beta activity, 81 $\mu\mu$c/g, was only slightly above normal. Additional analyses performed on this sample (see Table XVII on page 38) showed that it contained a normal uranium concentration but about twice the normal thorium concentration. Similar results were obtained for a sample collected on March 13 from the DuPage River at Naperville. In this sample the alpha activity (94 $\mu\mu$c/g) was about three times the normal value and the thorium concentration (8.2 $\mu\mu$c/g) about four times normal. Growth curves of the thorium separated from these samples indicated that the thorium consisted primarily of Th^{232} and its daughter Th^{228}. In both cases the thorium probably occurs naturally. The increased thorium concentrations apparently are localized, since other samples from the same beds contained normal amounts of thorium.

Except for the storage lagoon and the pond at location 3F, the alpha activities in samples collected on the ANL site were in the normal range. The average value, 25 $\mu\mu c\alpha$/g, was similar to the alpha activities found off the site. The average beta activity, 125 $\mu\mu$c/g, was about 30 $\mu\mu$c/g higher than the average activity found near ANL in 1959 and 25 to 60 $\mu\mu$c/g higher than the yearly averages found on the site prior to 1959. This was due to increased amounts of fallout activity; except for the storage lagoon there was no indication that the on-site samples contained significant amounts of activity from Argonne operations. The relative amounts of fission products of different half-lives were the same in samples collected on and off the site at the same time, indicating that the ages of the fission products were the same.

The total activities in bottom silt collected within 25 miles of ANL are listed in Table XIX and summarized in Table XX.

TABLE XXVIII

NONVOLATILE RADIOACTIVITY IN BED OF SAWMILL CREEK

Distance Downstream from Waste Water Outfall (yards)	Alpha Activity (pc/g)		Beta Activity (pc/g)	
	Nov. 14, 1960	Oct. 27, 1961	Nov. 14, 1960	Oct. 27, 1961
0	19	20	46	51
10	209	28	502	45
20	82	30	197	41
30	63	16	123	34
40	17	12	46	24
50	242	23	479	44
60	247	27	439	41
100	20	10	42	21
135	19	23	45	61
155	197	14	250	28
220	20	16	38	32
260	78	9	109	23
295	38	14	66	28
310	29	25	47	46
335	26	21	42	44

The same nuclides added to the creek in Argonne waste water contributed to the increased activity in below-outfall bottom silt samples, as shown in Table XXIV. Normal concentrations of uranium and thorium in bottom silt from the Chicago area are 1-3 pc/g based on previous analyses. The plutonium, strontium-90, and cesium-137 contents of bottom silt colected in 1959 from the Chicago area were < 0.1, 0.2-0.5, and 2-4 pc/g, respectively. Since the amount of fallout decreased sharply in 1960, these plutonium, strontium-90, and cesium-137 concentrations may be considered as present in the 1960 samples due to fallout. Thus, concentrations in excess of those given above were derived from Argonne waste water, and, as shown in Table XXIX, samples containing abnormally high alpha and beta activities also contained high concentrations of these nuclides.

TABLE XXIX

RADIOACTIVITY (pc/g) IN SELECTED BOTTOM SILT SAMPLES, 1960

Location	Date	Alpha	Beta	Uranium	Thorium	Plutonium	Strontium-90	Cesium-137
Sawmill Creek, 10 yards below outfall	September 7	50	173	11	-	-	-	-
Sawmill Creek, 10 yards below outfall	November 14	209	502	49	11	20	2.7	5.4
Sawmill Creek, 80 yards below outfall	November 14	247	493	40	-	-	3.9	2.7
Sawmill Creek, 155 yards below outfall	November 14	197	250	26	-	12	2.2	1.7
Sawmill Creek, 295 yards below outfall	November 14	38	66	3.6	0.85	2.7	<0.2	1.6
Des Plaines River, Lemont (below Sawmill Creek)	April 6	37	65	2.3	-	-	-	-
Illinois River, Morris	April 28	19	35	1.1	-	-	-	-
Lake Calumet, Chicago	November 17	32	65	3.1	-	-	-	-
Storage Lagoon, ANL	November 21	242	775	25	-	-	-	-

Bottom silt from Sawmill Creek above the site contained normal alpha and beta activities. Previous annual averages, 22-29 pcα/g and 60-93 pcβ/g, were similar to those in 1960 and 1961. Increases in the fall of 1961 due to fallout were small. Total alpha and beta activities in the Des Plaines River samples were in the normal range except during the last three months of 1961, when increases in beta activity due to recently produced fallout were detected. Differences between the two locations occurred in both directions in a random manner and could not be attributed to activity entering the river from Sawmill Creek. Thus, the sample collected on April 6, 1960, below Sawmill Creek contained 37 pcα/g, slightly higher than the usual alpha activity. However, the uranium content (2.3 pc/g) was in the normal range, plutonium and thorium were not detected, and the ratio of alpha activity to uranium concentration was normal. In addition, the sample contained normal amounts of beta activity, and since Sawmill Creek samples containing alpha activity from Argonne waste water have also contained elevated beta activities, Des Plaines River samples should behave similarly. The radioactivity in the April 6 Des Plaines River sample must, therefore, be considered normal. The high beta activities in October and December samples were due to above-normal amounts of fallout at the particular locations sampled. These samples contained the same fission products found in air during this period.

Table XXX gives the total activities found in other ponds and streams on the ANL site. Abnormally high activities were consistently found in samples from the storage lagoon for contaminated waste water.

TABLE XXX

NONVOLATILE RADIOACTIVITY IN BOTTOM SILT FROM OTHER PONDS AND STREAMS ON ANL SITE, 1960-61

Date Collected	No. of Samples	Alpha Activity (pc/g)		Beta Activity (pc/g)	
		Max	Av	Max	Av
April 29, 1960	3	325[a]	124	392[a]	179
	2[b]	26	24	75	73
July 28, 1960	3	26	25	54	48
September 30, 1960	2	28	25	63	58
November 21, 1960	4	242[a]	77	775[a]	228
	3[b]	23	22	48	46
August 29, 1961	3	30	29	54	51
September 22, 1961	4	46	31	58	47
Summary	19	325[a]	53	775	108
	17	46	26	75	52

[a]Sample collected from storage lagoon for contaminated waste water.

[b]Excluding samples collected from storage lagoon.

E. Surface Soil

The total activities in soil on the ANL site during 1960 and 1961 are given in Table XXXV. Normal activities range from approximately 10 to 30 pc/g for alpha activity and from 20 to 80 pc/g for beta activity. The lower values are generally encountered in sandy soils while soils containing clay and loam are more active. As indicated in the table, abnormally high activities were present in samples collected near a uranium-storage shed and near the storage lagoon for contaminated waste water. These activities result from the use made of these areas.

TABLE XXXV

NONVOLATILE RADIOACTIVITY IN SURFACE SOIL ON ANL SITE, 1960-61

Date Collected	No. of Samples	Alpha Activity (pc/g)		Beta Activity (pc/g)	
		Max	Av	Max	Av
April 29, 1960	3	24	20	69	57
July 26, 1960	12[a]	6100	606	4340	483
July 28, 1960	1	25	-	61	-
August 16, 1960	8[b]	26	22	81	54
August 19, 1960	1[c]	31	-	55	-
October 3, 1960	12[c]	47	26	82	55
November 21, 1960	6	28	22	55	47
	1[c]	74	-	248	-
1960 Summary	44	6100	187	4340	178
	31[d]	47	24	82	53
March 10, 1961	4	38	27	70	57
March 29, 1961	5	31	27	70	62
March 30, 1961	11	27	23	62	53
May 11, 1961	4	32	23	54	45
June 23, 1961	5[a]	40	26	91	63
August 29, 1961	9	41[c]	26	75	56
September 22, 1961	2	25	23	62	56
1961 Summary	40	41	25	86	56

[a]Collected near uranium-storage shed.
[b]Collected near EBWR and CP-5 Reactor Buildings.
[c]Collected near storage lagoon for contaminated waste water.
[d]Excluding uranium-storage area and November 21 sample from lagoon area.

Additional analyses confirmed the presence of uranium in soil collected near the storage shed. Surface soil in the Chicago area normally contains about 2 pc of uranium per gram, while the uranium content of the soil near the storage shed ranged from normal amounts to about 6000 pc/g.

Abnormal uranium concentrations were detected up to 75 ft from the shed, an increase over the 40-ft radius of contamination found earlier.

The abnormally high activities in soil collected near the storage lagoon were due to the same nuclides added to Sawmill Creek in Argonne waste water. The contamination was confined to an area that carries overflow lagoon water to Sawmill Creek. At other locations near the lagoon the soil activities were normal.

Iodine-131 was detected in surface soil collected near the building from which the bulk of the iodine was released during February and March 1961. This release, and the resulting airborne iodine-131 concentrations, are discussed in Section II-A. The radioiodine concentrations in soil ranged from less than 0.3 to 104 pc/g at the time of collection, March 29-30. The results are tabulated in Section F in order to compare them with the concentrations in grass collected at the same time. The presence of iodine-131 is not apparent from the results given in Table XXXV since these activities were determined after the samples were dried at 110°C. Drying for several hours at this temperature removed essentially all of the iodine-131. The iodine-131 concentrations were determined on separate, undried portions of the samples.

Other samples collected on the ANL site during 1960 and 1961 contained normal amounts of activity. Recent fallout activity was not apparent in the samples collected on September 22, 1961.

The total activities in soil collected within 25 miles of the ANL site are given in Table XXXVI. The average alpha activity, about 20 pc/g, was normal, and the average beta activity, about 50 pc/g, was very similar to that found in other years when fallout activity was low.

Several samples were analyzed for uranium, plutonium, and thorium. The uranium content varied from 1.7 to 2.2 pc/g and thorium concentrations ranged from 0.016 to 0.021 pc/g. These values are similar to those obtained in other years. Plutonium concentrations were between 0.03 and 0.05 pc/g, and are attributed to fallout.

The total activities in samples collected from the reference sites are given in Table XXXVII. The results were very similar to those obtained earlier. As was noted for the on-site samples, the total beta activities in the off-site samples collected after September 1961 did not show any significant increase from the atmospheric nuclear testing during this period.

3. Ground Water

The Laboratory domestic water is provided by four wells which are described in Section I.E. and the locations are shown in Figure 1. Samples from each well were collected quarterly at the well head and analyzed for several types of radioactivity. The 1985 results are in Table 11. In addition to the well water samples, one tap water sample was collected and the results are also in Table 11.

Since the Laboratory is a "non-community water system",[11] the EPA standards for this type of system apply. For the nuclides measured in Table 11, the following limits are established:

Gross alpha particle activity	*15 pCi/L (10^{-9} μCi/mL)*
Gross beta particle activity	*15 pCi/L (10^{-9} μCi/mL)*
Hydrogen-3	*2 x 10^{4} pCi/L (10^{-9} μCi/mL)*
Strontium-90	*8 pCi/L (10^{-9} μCi/mL)*
Radium-226	*5 pCi/L (10^{-9} μCi/mL)*

The uranium results would be covered by the gross alpha standard. Inspection of Table 11 indicates that all measurements are well within the EPA drinking water standards. This program is being conducted to demonstrate the Laboratory's compliance with the EPA drinking water regulations.

Wells 1 and 2 had measurable levels of hydrogen-3 at various times during the year, although the average concentration was only 1% of the EPA Standard. It is speculated that the source of the hydrogen-3 was from liquid wastes that were placed in holding ponds in the sewage treatment area (Location 10M in Figure 1) in the 1950's. The tritiated water migrated down through the soil to the dolomite, and was drawn into the wells. Well 1, which is about 200 m north of the treatment area, had higher hydrogen-3 concentrations than Well 2, which is about 300 m from the treatment area. Although the normal subsurface water flow gradient is in the south direction, the cone of depression created by the pumping on these wells would overpower the normal pattern. The holding ponds have not been used for a number of years. Two hydrogen-3 results from Well 3 were very

TABLE 11

Radioactivity in ANL Domestic Wells, 1985

(Concentrations in 10^{-9} μCi/mL)

Type of Activity	Location	No. of Samples	Avg.	Min.	Max.
Alpha (nonvolatile)	Well #1	4	4.1 ± 1.0	2.9	5.0
	Well #2	4	4.0 ± 1.1	2.8	5.2
	Well #3	4	3.0 ± 0.5	2.4	3.4
	Well #4	3	2.5 ± 1.3	1.8	3.6
	Tap	1	-	-	0.4
Beta (nonvolatile)	Well #1	4	7.8 ± 1.6	6.3	9.6
	Well #2	4	6.7 ± 0.9	5.6	7.6
	Well #3	4	6.4 ± 1.2	5.1	7.6
	Well #4	3	5.9 ± 2.2	4.1	7.1
	Tap	1	-	-	5.1
Hydrogen-3	Well #1	4	220 ± 41	181	257
	Well #2	4	161 ± 130	< 100	333
	Well #3	4	111 ± 15	< 100	125
	Well #4	3	-	-	< 100
	Tap	1	-	-	114
Strontium-90	Well #1	1	-	-	< 0.25
	Well #2	1	-	-	< 0.25
	Well #3	1	-	-	< 0.25
	Well #4	1	-	-	< 0.25
	Tap	1	-	-	< 0.25
Radium-226	Well #1	1	-	-	1.27
	Well #2	1	-	-	1.01
	Well #3	1	-	-	0.72
	Well #4	1	-	-	0.76
	Tap	1	-	-	0.12
Uranium-234	Well #1	1	-	-	0.23
	Well #2	1	-	-	0.18
	Well #3	1	-	-	0.26
	Well #4	1	-	-	0.12
	Tap	1	-	-	0.06
Uranium-238	Well #1	1	-	-	0.16
	Well #2	1	-	-	0.17
	Well #3	1	-	-	0.18
	Well #4	1	-	-	0.12
	Tap	1	-	-	0.15

slightly above the detection limit, but these are considered to be within the normal fluctuation range for the measurement of hydrogen-3 in water.